A systematic review and meta-analysis of controlled interventions to reduce burnout in physicians.

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This manuscript has not been presented at any academic meeting.

Author Contributions

The original idea for the research was developed by MP, EF, and AE. The analysis was conducted by MP with input from EK, EP, PB, and AE. MP, KG and SD conducted the searches, study selection, quality assessments and other data extraction. MP wrote the

paper. All authors interpreted the findings and contributed to critical revision of the manuscript. MP is the guarantor. MP affirms that the manuscript is an honest, accurate, and transparent account of the research findings and no important aspects of the study have been omitted.

Conflict of interests

All authors declare no conflict of interest

Word count (not including abstract, tables, acknowledgment, or references):

3,425

Abstract

IMPORTANCE: Burnout is prevalent in physicians and can have a negative influence on performance, career continuation and patient care. Existing evidence does not allow clear recommendations for the management of burnout in physicians.

OBJECTIVE: To evaluate the effectiveness of interventions to reduce burnout in physicians. We also examined whether different types of interventions (physician-directed or organization-directed interventions), physician characteristics (length of experience) and healthcare setting characteristics (primary or secondary care) were associated with improved effects.

DATA SOURCES: Medline, Embase, PsycINFO, Cinahl, and Central, were searched from inception to May 2016. The reference lists of eligible studies and other relevant systematic reviews were hand-searched.

STUDY SELECTION: Randomized controlled trials and controlled before-after studies of interventions targeting burnout in physicians.

DATA EXTRACTION AND SYNTHESIS: Two independent reviewers extracted data and assessed the risk of bias. The main meta-analysis was followed by a number of pre-specified subgroup and sensitivity analyses. All analyses were performed using random-effects models and heterogeneity was quantified using I^2.

MAIN OUTCOME AND MEASURES: The core outcome was burnout scores focused on emotional exhaustion, reported as standardized mean differences and their 95% confidence intervals.

RESULTS: Twenty independent comparisons from 19 studies were included in the meta-analysis (n=1,550 physicians). Interventions were associated with small significant reductions in burnout (SMD=-0.29, 95% CI=-0.42 to -0.16; equal to a drop of 3-points on the emotional exhaustion domain of the Maslach Burnout Inventory above change in the controls). Subgroup analyses suggested significantly improved effects for organization-

directed interventions (SMD=-0.45, 95% CI=-0.62 to -0.28) compared to physician-directed interventions (SMD=-0.18, 95% CI=-0.32 to -0.03). Interventions delivered in experienced physicians and in primary care were associated with higher effects compared to interventions delivered in inexperienced physicians and in secondary care, but these differences were not significant. The results were not influenced by the risk of bias ratings. CONCLUSION: Evidence from this meta-analysis suggests that current intervention programs for burnout in physicians are associated with small benefits which may be boosted by adoption of organization-directed approaches. This finding provides support for the view that burnout is a problem of the whole healthcare organization, rather than individuals.

Introduction

Burnout is a syndrome consisting of emotional exhaustion, depersonalization, and a diminished sense of personal accomplishment, which is primarily driven by workplace stressors.[1-3] Burnout is a major concern for physicians. Nearly half of practicing physicians in the United States experience burnout at some point in their career [4] Although there are substantial differences by specialty, physicians at the front line of care report the highest rates of burnout.[5]

Burnout has serious negative consequences for physicians, the healthcare system and for patient outcomes. Burnout in physicians has been linked with lower work satisfaction, disrupted personal relationships, substance misuse, depression, and suicide.[6,7] Within health care organizations, burnout is related to reduced productivity, high job turnover and early retirement.[8] [9,10] Importantly, burnout can result in an increase in medical errors, reduced quality of patient care and lower patient satisfaction.[11-16] It is not surprising therefore, that wellness of physicians is increasingly proposed as a quality indicator in healthcare delivery. [17]

Leading drivers of burnout include excessive workload, imbalance between job demands and skills, a lack of job control, and prolonged work stress.[18] Recently, there has been a shift from viewing burnout as an individual problem, to a problem of the healthcare organization as a whole; rooted in issues related to working environment and organizational culture.[19] It has been suggested that reducing risk of burnout in physicians requires change in organizations, as well as support for individual physicians.[20]

Interventions for burnout can be classified into two main categories, physician-directed interventions targeting individuals and organization-directed interventions targeting the working environment. [21,22] Physician-directed interventions typically involve mindfulness techniques or cognitive behavioral techniques to enhance job competence, improve communication skills and personal coping strategies. Organization-directed interventions can involve simple changes in schedule and reductions in the intensity of workload or more ambitious changes to the operation of practices and whole healthcare organizations. These usually involve improved team-working, changes in work evaluation, supervision to reduce job demand and enhance job control, and increasing the level of participation in decision making.

We conducted a systematic review and meta-analysis of studies which evaluated interventions to reduce burnout in physicians. We decided to focus on burnout scores as the main outcome of this review because burnout is the best recognized serious negative consequence of work stress in physicians[19,23] and the most commonly reported, and consistently measured, outcome of work stress interventions. [21,22,24] Moreover, by focusing on burnout, we established a level of homogeneity in terms of outcomes which allowed us to test our aims meta-analytically.

Our first objective was to assess the effectiveness of interventions in reducing burnout. Second, we examined what types of interventions are the most effective (organization-directed, physician-directed). Thirdly, we examined whether there are any differences in the effect of interventions in different healthcare settings (primary care, secondary/intensive care) and in physicians with different levels of working experience. Our rationale was that physicians working in different organizational

settings or physicians with different levels of experience might have diverse needs and might respond differently to burnout interventions.

Methods

The reporting of the review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (eTable 1).[25] The protocol is included in eMethods1.

Eligibility criteria

- Population: Physicians of any specialty in primary, secondary or intensive care setting including residents and fellows. Studies based on a mix of physicians and other healthcare professionals were included in the review if the physicians comprised 70% of the sample.
- Intervention: Any intervention designed to improve stress/performance of physicians and reported burnout outcomes including physician-directed interventions and organization-directed interventions. Physician-directed interventions focused on individuals (e.g. cognitive behavioral therapies, mindfulness stress reduction techniques, educational programs for improving communication skills) whereas organization-directed interventions introduced changes in the resources, the working environment, work tasks to decrease stress (e.g. changes in the intensity/schedule of workload or deeper improvements in the operation of healthcare organizations and the teamwork).
- Comparison: Any type of control (e.g. waiting list or no intervention)
- Outcome: Burnout measured using validated tools such as the Maslach Burnout Inventory (MBI),[1] or other validated measures that measured burnout.

- Study design: Quantitative intervention designs described in the Cochrane handbook including RCTs, non-randomized trials, controlled before-after studies and interrupted time-series.
- Context: Any healthcare setting including primary care and secondary care.

Exclusion criteria:

- Interventions not reporting data on burnout outcomes but providing data on general stress, well-being or job satisfaction.
- Grey literature

Search strategy and data sources

Five electronic bibliographic databases were searched from inception until May 2016: MEDLINE, EMBASE, CINAHL, Cochrane Register of Controlled Trials and PsycINFO. The search strategy included combinations of three key blocks of terms (burnout; physicians; interventions) using medical subject headings (MESH terms) and text-words (eMethods2). Searches were supplemented by hand searches of the reference lists of eligible studies and systematic reviews.

Study selection

The results of the searches were exported in Endnote and duplicates were removed. Study selection was completed in two stages. First, the titles and abstracts of the studies were screened and subsequently the full-texts of relevant studies were accessed and further screened against the eligibility criteria. The title/abstract screening was undertaken by the first author whereas two independent reviewers were involved in full-text screening. Inter-rater reliability was high (kappa = 0.96). Disagreements were resolved through discussions.

Data extraction

An Excel data extraction form was developed and initially piloted in five randomly selected studies. Quantitative data for meta-analysis were extracted on a separate extraction sheet. Authors were contacted when data were missing or incomplete. The following descriptive information was extracted from the studies:

- Study: research design, method of recruitment and content of control
- Participants: sample size, age, gender, setting/specialty, years of work experience
- Intervention: content, delivery format, intensity, follow-up time points
- Outcomes: scores in burnout including emotional exhaustion, depersonalization and professional accomplishment.

Risk of bias assessment

The critical appraisal of the studies was performed using the Effective Practice and Organisation of Care (EPOC) risk of bias tool.[26] EPOC was chosen because it is appropriate for use across all types of intervention designs described in the Cochrane handbook. The EPOC tool contains nine standardized criteria scored on a 3-point scale, corresponding to low, unclear, and high risk.

Data analysis

Standardized Mean Differences (SMDs) and associated confidence intervals (CI) for the burnout outcomes of all the studies were calculated in Comprehensive Meta-Analysis (CMA). [27] The pooled SMDs and the forest plots were computed using the metan command in Stata 14.[28] The main meta-analysis evaluated the effectiveness of the interventions in reducing burnout. The MBI measure for burnout provides

ratings in three domains (emotional exhaustion, depersonalization and personal accomplishment). It is not recommended they are combined.[1] In line with previous meta-analyses, we used only the emotional exhaustion domain of MBI in the analyses.[29] Emotional exhaustion is considered the most central aspect of burnout (some studies only use this domain) and other unidimensional measures of burnout focus on emotional exhaustion.[29,30] To ease the interpretation of the results we "back-transformed" the pooled SMD to a mean difference for the emotional exhaustion subscale, under certain assumptions. When data were available for more than one follow-up assessment points, the short-term assessment point were inserted in the main analysis. Three pre-specified subgroup analyses [31] were carried out:

i. *Type of interventions* – we tested the effectiveness of physician-directed, and organization-directed interventions.
ii. *Working experience of physicians* – we examined the differential treatment effects across studies recruited physicians with extensive working experience (mean = 5 years or more) and studies recruited physicians with low experience (mean= less than 5 years). All studies classified into the low experience category explicitly reported in the methods that they recruited junior physicians.
iii. *Healthcare setting*– we tested the effects of interventions separately in physicians based in primary care and in secondary care.

Two sensitivity analyses were performed. We examined the effects of interventions on the other two domains of MBI (depersonalization and personal accomplishment). We also examined whether effects were robust when only studies with low risk of bias scores were retained in the analyses.

Heterogeneity was assessed using the I^2 statistic. Conventionally, I^2 values of 25%, 50%, and 75% indicate low, moderate, and high heterogeneity.[32] All analyses were conducted using a random effects model, even if I^2 was low. Random-effects models are more conservative and have better properties in the presence of any heterogeneity. [33,34] The Cohen's Q test of between group variance was used to test whether the effectiveness of burnout interventions is significantly different across sub-groups. Cluster RCTs were identified and the precision of analyses adjusted using a sample size/variation inflation method, assuming an intra-class correlation of 0.02. Provided we identified 10 or more studies,[35] we aimed to use funnel plots and Egger's test to assess small sample bias (an indicator of possible publication bias). [36] Funnel plots were constructed using the metafunnel command,[37] and the Egger test was computed using the metabias command.[38]

Results

The search strategy yielded 2,322 articles. Following the removal of duplicates, 1723 articles were retained for title and abstract screening. Of these, 75 were relevant for full-text screening and 19 studies were included in the review.[39-57] One study included a marginally lower percentage of physicians (67%) but we retained it in the analyses to maximize the evidence base. [41]

Characteristics of studies and physicians

Table 1 presents the characteristics of the 19 studies (including 20 independent comparisons on 1,550 physicians, mean age=40.3 years). Eight studies were conducted in the US (42%), four in Europe, three in Australia, two in Canada, one in Argentine and one in Israel. A higher proportion of men were recruited in the majority of studies.

Seven studies recruited physicians working in primary care (mostly labelled 'general practitioners'), ten studies recruited physicians in secondary care (e.g. physicians in intensive care units, oncologists and surgeons) and two studies recruited a mixed sample of physicians who were recruited through their registration in national medical associations. Across all interventions, the main eligibility criteria were being a physician (working on a specific setting in most cases) and willingness to take part in the study. None of the studies specifically targeted physicians with certain severity levels of burnout. The majority of studies (n=12; 67%) were based on experienced physicians (mean working experience= 5 years and over) whereas seven studies were based on recently qualified physicians (mean working experience=less than 5 years). With the exception of one study,[39] all used the MBI to assess the severity of burnout (eTable 2).

Characteristics of Interventions

Interventions varied considerably in their characteristics including content, duration/intensity, and length of post-intervention assessment points (see Table 1). The majority (n=12; 60%) were physician-directed interventions which comprised mindfulness stress reduction techniques, educational interventions targeting physicians' self-confidence and communication skills, exercise or a combination of these features.

Within the category of organization-directed interventions, five studies evaluated simple workload interventions which focused on rescheduling hourly shifts and reducing workload. Only three studies tested more extensive organization-directed interventions incorporating discussion meetings to enhance teamwork and

leadership, structural changes, and elements of physician interventions such as communication skills training and mindfulness.

The duration of the interventions ranged from 2 weeks to 9 months. Follow-up assessment points ranged from 1 day to 18 months post-intervention. All interventions were delivered in face to face format.

Risk of bias characteristics

The results of the risk of bias assessment are presented in eFigure 1. Eighteen comparisons were RCTs (95%) whereas two were CBA. Fifteen comparisons (75%) fulfilled 6 of the 9 risk of bias criteria (a higher score indicates lower vulnerability to bias). Three comparisons fulfilled 8 to 9 criteria (17%) while 5 fulfilled 4 or fewer criteria (25%); most moderately accounted for the risk of bias criteria.

Main meta-analysis: Effectiveness of interventions in reducing burnout

Interventions were associated with small, significant reductions in burnout (SMD=-0.29, 95% CI=-0.42 to -0.16, I^2 =30%, 95% CI=0 to 60; Figure 2). The back-transformed emotional exhaustion score for the intervention group was 15.1 (95% CI=13.9 to 16.5), compared to a control group score of 17.9 and assuming a standard deviation of 8.97 for the effect.

Subgroup analyses

Types of interventions: Physician-directed interventions were associated with small significant reductions in burnout (SMD=-0.18, 95% CI=-0.32 to -0.03, I^2=11%, 95%CI=0 to 49; back-transformed emotional exhaustion score =16.2, 95%CI=14.7 to 17.3 compared to a control group score of 17.9) whereas organization-directed interventions were associated with medium significant reductions in burnout (SMD=-0.45, 95% CI=-0.62 to -0.28, I^2=19%,

95%CI=0 to 60; back-transformed emotional exhaustion score=13.9, 95% CI=12.4 to 14.7 compared to a control group score of 17.9; Figure 3). The effects of organization-directed interventions were significantly larger than the effects of physician-directed interventions (Cohen's Q = 4.15, P=0.04).

Working experience: The pooled effect of interventions on burnout scores was medium and significant across studies mainly based on experienced physicians (SMD=-0.37, 95% CI= -0.58 to -0.16, I^2=42%, 95%CI=0 to 70; back-transformed emotional exhaustion score =14.6, 95%CI=12.7 to 16.5 compared to a control group score of 17.9) and small and significant across studies on physicians with limited experience (SMD=-0.27, 95% CI=-0.40 to -0.14, I^2=0%, 95%CI=0 to 75; back-transformed emotional exhaustion score =15.5, 95%CI=13.8 to 16.9 compared to a control group score of 17.9; eFigure 2). This group difference was non-significant (Q=0.92, P=0.34).

Healthcare setting: Interventions in primary care were associated with small to medium reductions in burnout (SMD=-0.39, 95% CI=-0.59 to -0.19, I^2=4%, 95%CI=0 to 69; back-transformed emotional exhaustion score =14.4, 95%CI=12.6 to 16.2 compared to a control group score of 17.9). Interventions in secondary care were associated with small significant reductions in burnout (SMD=-0.24, 95% CI=-0.41 to -0.07, I^2=41%, 95%CI=0 to 65; back-transformed emotional exhaustion score = 15.7, 95%CI=13.9 to 17.4 compared to a control group score of 17.9; eFigure 3). This difference was non-significant (Q=0.51, P=0.48).

Sensitivity analyses

The treatment effect derived by studies at lower risk of bias (i.e. scoring low on 6 of the 9 risk of bias criteria) was similar to the overall effects of the main analysis (SMD=-0.32, 95% CI=-0.49 to -0.14, I^2=42%, 95%CI=0 to 70; eFigure 4).

Interventions were associated with very small significant reductions in depersonalization (SMD=-0.21, 95% CI=-0.35 to -0.06, I^2=33%, 95%CI=0 to 68%; eFigure 5) and small improvements in the personal accomplishment (SMD=0.30, 95% CI=0.15 to 0.45, I^2=0%, 95%CI=0 to 58%; eFigure 6). The subgroup analyses in these two domains showed similar results but were based on a smaller number of studies (eTable 3).

Small study bias

We found no evidence of funnel plot asymmetry which might indicate publication bias for the main, or subgroup analyses (Egger test P=0.11 for main analysis; Figure 4).

Discussion

Summary of main findings

This meta-analysis showed that interventions for physicians are associated with small significant reductions in burnout. Organization-directed interventions were associated with higher treatment effects compared to physician-directed interventions. Interventions targeting experienced physicians and delivered in primary care showed evidence of greater effectiveness compared to interventions targeting less experienced physicians and delivered secondary care, but these group differences were non-significant.

Strengths and limitations

This is a comprehensive meta-analysis of controlled interventions aimed at reducing physician burnout. The two greatest threats for the validity of meta-analysis are heterogeneity and publication bias. However, the biggest strength of this work is the large number of identified and meta-analyzed controlled comparisons (20, when approximately 11.5% of all meta-analyses include 10 or more studies), which allows us to reliably estimate

412 and model heterogeneity levels.[58] In addition, the size of the meta-analysis allowed us to
413 assess publication bias with adequate power.[35] Although publication bias tests are rarely
414 conclusive, we did not observe any bias indications in the plot or test.
415
416 The included studies differed significantly in terms of content of interventions, study
417 design/quality and length of follow-up which limit the extent to which broad conclusions can
418 be made about the overall effectiveness of physician interventions. However, estimates of
419 heterogeneity in the pooled analyses were low to moderate by conventional thresholds and
420 random effects models were applied in all analyses.[59] Heterogeneity was further addressed
421 by conducting pre-specified subgroup analyses (within the limits of power).[60] While this is a
422 useful approach for producing guidance to design and deliver the most effective
423 interventions, subgroup analyses should be interpreted cautiously because other,
424 uncontrolled differences between studies might account for the results.[61,62]
425
426 **Comparison with previous systematic reviews**
427 Three existing systematic reviews examined the effectiveness of work stress interventions in
428 healthcare professionals with only one of these specifically focused on physicians. [22,63,64] Our
429 findings regarding the overall effectiveness of burnout interventions and the increased
430 effectiveness of organizational interventions are in agreement with the most recent meta-
431 analysis on physician burnout.[64] In comparison, we narrowed our attention to controlled
432 interventions and we undertook an additional evidence-based pre-specified subgroup
433 analyses to examine whether the characteristics of interventions, physicians and healthcare
434 settings influence the overall effect of burnout interventions. This decision was based on
435 the recognition that controlled interventions offer the best opportunity to reach rigorous
436 conclusions about the effectiveness of the tested interventions and that intervention studies
437 on physician burnout are highly heterogeneous. This approach enabled us to draw

informative conclusions for the effectiveness of burnout interventions among physicians which take into account the influence of the distinct features of interventions, physicians and healthcare settings.

Implications for researchers, clinicians and policymakers

Even though many studies have examined risk factors for burnout in physicians, relatively few intervention programs have been developed and evaluated. Our main finding is that the treatment effects were significant but small, equal to a 3-point reduction in the emotional exhaustion domain of the MBI. At present, the low quality of the research evidence does not allow firm practical recommendations but we offer some insights for research and clinical directions.

Organization-directed interventions were more likely to lead to reductions in burnout but there were large variations in terms actual approaches, intervention ingredients and intensity. Those which combined several elements such as structural changes, fostering communication between members of the healthcare teams and cultivating a sense of team-work and job control tended to be the most effective in reducing burnout. [47] However, such intense organization-directed interventions were rare and were not evaluated widely. The majority of organization-directed interventions, which we included in the analyses, introduced simple reductions in the workload or schedule. Concerns around implementation and delivery costs of organization-directed interventions, especially if they involve complex and major healthcare system changes, might explain their scarcity.[21,65] A recent example promoting healthy individual-organization relationships is the Listen-Act-Develop model implemented in Mayo Clinic.[66] Large-scale cluster-randomized trials of such programs at institutional or even at national level which emphasize organizational culture by

creating a safe space for staff to acknowledge and decrease stress are possibly an optimal framework for mitigating burnout.

Physician-directed interventions led to marginally significant and very small reductions in burnout. We found no evidence that the content (e.g. mindfulness, communicational, educational components) or intensity of these interventions might increase the derived benefits based on our critical review. This finding in combination with the larger effects of organization-directed interventions, support the argument that burnout is rooted in the organizational coherence of the healthcare system.[20,67] If burnout is a problem of whole healthcare systems it is less likely to be effectively minimized by solely intervening at the individual level. It requires an organization-embedded approach.[68] Moreover, physicians expected to deal with burnout individually and remotely from their practicing organization might view physician-directed interventions as a personal responsibility (or blame themselves for being less 'resilient') rather than as a shared resource to create a flourishing healthcare environment. [66,69] There is some evidence that elements of the physician-directed interventions (e.g. mindfulness) are effective when supported by organizational approaches.[24, 70] However, other unexamined factors at the process of the intervention delivery or at participant level might account for the observed differences in the effectiveness of organization-directed and physician-directed interventions. Research programs to understand the best context for the delivery, evaluation and the implementation of burnout interventions are required.[71-73]

Physicians based in different healthcare settings or at different stages of their career might face unique challenges and have different needs. We found smaller benefits for recently qualified and secondary care physicians. The evidence indicates that young physicians are at higher risk for burnout compared to experienced physicians,[5] so future research should

focus on prevention among less experienced physicians. Interventions focused on enhancing teamwork, mentoring and leadership skills might be particularly suitable for young physicians and for physicians dealing with intense work and complex patients.[74-76]

Conclusion

This meta-analysis found that physicians can gain important benefits from interventions to reduce burnout, especially from organization-directed interventions. However, this evidence is derived from interventions developed and evaluated in diverse groups of physicians and healthcare settings. Burnout is associated with serious risks to both physicians and patients, thus it is imperative that physicians have access to evidence-based interventions that reduce the risk for burnout.

Acknowledgments

This study was funded by the UK National Institute of Health Research (NIHR) School for Primary Care Research (Study no: R119013). The MRC Health eResearch Centre grant MR/K006665/1 supported the time and facilities of EK. The research team members were independent from the funding agency. The views expressed in this publication are those of the authors and not necessarily those of the National Health Service, the NIHR, or the Department of Health. The funders had no role in the design and conduct of the study; the collection, management, analysis, and interpretation of the data; and the preparation, review, or approval of the manuscript.

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Figure 1: PRISMA flowchart

Figure legend: Flowchart of the inclusion of studies in the review

Figure 2: Forest plot of the effects of interventions on burnout scores

Figure legend: Meta-analysis of individual study and pooled effects. Each line represents one study in the meta-analysis, plotted according to the standardized mean difference (SMD – roughly the difference between the average score of participants in the intervention group, and the average score of participants in the control group). The black box on each line shows the SMD for each study and the blue box represents the pooled SMD. Random effects model used. 95% CI=95% confidence intervals.

Figure 3: Forest plot of the effects of different types of interventions on burnout scores

Figure legend: Subgroup analysis of individual study and pooled effects of physician-directed and organization-directed interventions on burnout scores. Each line represents one study in the meta-analysis, plotted according to the standardized mean difference (SMD). The black box on each line shows the SMD for each study and the blue box represents the pooled SMD. Random effects model used. 95% CI=95% confidence intervals; ES=Standardized mean difference

Figure 4: Funnel plot of standardized mean differences versus standard error for burnout scores

Figure legend: Funnel plot with pseudo 95% confidence intervals. The outer lines indicate the triangular region within which 95% of studies are expected to lie in the absence of both biases and heterogeneity. Funnel plot shows no substantial asymmetry (Egger's regression intercept −0.28, SE=0.16, P=0.11) [77]

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Table 1: Characteristics of studies and interventions included in this review

Study	Country	Recruitment and eligibility	Health care setting	N	Males	Mean Age	Work years	Research design	Intervention	Control	Follow-up point
Ali et al.[39] 2011	US	Physicians with various specialties working in intensive care units.	Intensive care	45	76%	M=41 years	M=8 years	Cluster RCT	*Organization-directed (focused on workload or schedule)*: Two intensivist staffing schedules were compared: continuous and interrupted (rotations every 2 weeks) for 14 months.	Continuous schedule	9 months
Amutio et al.[40] 2015	Spain	Physicians with various specialties registered in a national medical organization.	Mixed sample of physicians; Registration in a medical professional organization	42	43%	M=43 years	M=9 years	RCT	*Physician-directed:* A 2-month mindfulness-based stress reduction program which involved a weekly powerpoint presentation of stressful topics related to the medical profession (ie. healing with suffering), a weakly 45 minute mindfulness exercise, a weekly 60-minute group reflection about the weekly topic and the mindfulness exercise.	Waiting list	1 month
Asuero et al.[41] 2014	Spain	Physicians and allied health professionals in	Primary care	68	8%	M=47 years	M=10 years	RCT	*Physician-directed*: A 2-month (8 sessions of 2.5 hours per week plus a 1-	Waiting list	2 months

		primary care were invited to participate.							day session of 8 hours) contemplation-meditation exercises such as mindfulness meditation, where participants focus on the present-moment experience and contemplate nonjudgmentally bodily sensations, breathing, sounds, and thoughts.		
Bragard et al.[42] 2010	Belgium	Internal medicine residents with an interest in a psychological training and to be willing to participate in the training program.	University-based hospital	113	60%	M=28 years	M=3 years	RCT	*Physician-directed*: a 30-hour communication skills training and a 10-hour stress management skills training in small groups (up to seven participants).	Waiting list	2 months
Butow et al.[44] 2008	Australia	Oncologists from six tertiary care hospitals in six Australian cities which incorporated oncology outpatient clinics were eligible.	Teaching hospitals, oncology unit	30	50%	M=44 years	M=16 years	RCT	*Physician-directed:* 1.5-day intensive face to face workshop with three to six participants incorporating presentation of principles, a DVD modelling ideal behavior and role-play practice, followed by four 1.5 hour video-conferences at monthly intervals	Waiting list	3 and 6 months

									incorporating role-play of doctor-generated scenarios.		
Butow et al.[43] 2015	Australia	Oncologists working in major cancer centers involved in the treatment of patients with early breast cancer were eligible.	Cancer centers or clinics	41	37%	M=45 years	Over 6 years	RCT	*Physician-directed:* A 7-h interactive face to- face workshop training with a follow-up telephone call 1 month later. The elements of the training workshop were evidence-based and used accepted adult learning principles.	No intervention	Post-intervention
Garland et al.[45] 2012	Canada	Physicians in intensive care Units	Intensive care units	24	92%	Range 41-60 years	Most over 10 years	Crossover RCT	*Organization-directed (focused on workload):* Shift work staffing in which there was 24/7 intensivist presence. The same pool of intensivists supplied dayshift and nightshift coverage. In any given week, a single intensivist was responsible for all seven dayshifts (08:00–17:30, 08:00–15:00 on weekends), whereas two different intensivists alternated the seven nightshifts.	Standard staffing: one intensivist staffed an ICU for 7 days, was present during daytime, and took calls from home at night, returning to ICU as deemed necessary.	Post-intervention

Gunasingam et al.[46] 2015	Australia	Postgraduate year 1 doctors in a single hospital were eligible.	Teaching hospital	31	52%	25 -30 years	M=1 year	RCT	*Physician-directed:* 3 1-hour debriefing sessions and a focus group involving planning the management of the sessions, discussing the recording sheet to identify themes raised by the participants and agreement for a process if a participant disclosed a serious matter warranting action.	No intervention	2 weeks
Linzer et al.[47] 2015	US	Physicians working within 34 primary care clinics were eligible.	Primary care	135	48%	M=46	M=12 years	Cluster RCT	*Organization-directed (focused on communication, teamwork and quality improvement):* a) targeted quality improvement (QI) projects; b) communication and changes in workflow	No intervention	12-18 months
Lucas et al.[48] 2012	US	The general medicine inpatient service of a 500-bed public teaching hospital.	General medicine of Hospital	62	52%	M=38	M=4 years	Cluster RCT	*Organization-directed (focused on workload or schedule)*: Assignment to random sequences of 2-week shift rotations.	4-week rotations	1 month
Margalit et al.[49] 2005	Israel	General practitioners randomly selected.	Primary Care	102	n/r	n/r	M=9 years	RCT	*Physician-directed:* A weekly 4–6 hour workshop for a total of 12 weeks. Interactive	Didactive group	6 months

									teaching intervention aiming to impart the knowledge, attitudes and skills needed for adapting to the task of a physician in a busy community clinic.		
Martins et al.[50] 2011	Argentine	Pediatric residents in a tertiary hospital	Tertiary hospital	74	20%	M=27	Mostly experienced (over 5 years)	RCT	*Physician-directed:* A brief intervention consisting of two 2.5 hours self-care workshops coordinated by mental health professionals, who addressed aspects of burnout syndrome such as identification of risk factors, coping behaviors, preventive behaviors and self-care.	No intervention	2 months
Milstein et al.[51] 2009	US	Pediatric house physicians	Primary care	15	47%	n/r	M=11 Years	RCT	*Physician-directed*: 45-minute stress reduction intervention where one reflects on the background of the situation that may have generated stress professionally, examines one's affect, or how one feels about a situation, analyses the most troublesome aspects of the situation, individual's expertise, reflects upon	No intervention	3 months

									how one handled the situation, and provides oneself empathy (supportive comments).		
Parshuram et al.[52] 2015	Canada	Physician-Residents in anesthesia, surgery and emergency medicine training programs, who performed in-house overnight duty were eligible.	Intensive care units	47	n/r	n/r	Range= 1-3 years	RCT	*Organization-directed (focused on workload or schedule)*: Residents in 2 university-affiliated Intensive care units were randomly assigned (in 2-month rotation-blocks from January to June 2009) to in-house overnight schedules of 12 hours.	16 and 24 overnight schedules	Post-intervention
Ripp et al.[53] 2014	US	All first year residents in an Internal Medicine Unit were eligible,	Internal Medicine Residence program	51	n/r	n/r	M=1 year	RCT	*Physician- directed:* 18 one-hour bimonthly practicing physician groups who met regularly with trained discussion group leaders to discuss topics related to stress, balance, and job satisfaction experienced decreased job burnout.	Lunch vouchers	Post-intervention
Shea et al.[54] 2014	US	Graduate internal medicine interns in the Oncology department of Hospital.	Internal medicine a hospital	100	56%	28 years	Range= 1-2 years	RCT	*Organization-directed (focused on workload or schedule)*: a 5-hour period of protected time in which interns were expected to	No intervention	Post-intervention

									sleep (12.30amto 5.30 am) for 4 weeks.		
Verweij et al.[55] 2016	Netherlands	General practitioners affiliated with Dutch training Hospitals were eligible.	Primary Care	50	66%	M=55	M=24 years	Controlled before-after study	*Physician-directed:* Eight weekly sessions each lasting 2.5 hours, and a 1-day silent retreat between the sixth and seventh session focused on mindfulness. Participants were encouraged to focus their attention on the present moment and to observe their own thoughts, feelings, and behavior in a non-judgmental way. Some of the themes discussed were: awareness of pleasant or unpleasant sensations, feelings, or thoughts; perceptual biases and filters; burnout; boundaries or conflict management; and self-care.	Waiting list	Post-intervention
Weight et al.[56] 2013		All residents and fellows at Mayo Clinic in Rochester	Secondary care (various specialties) in Mayo clinic	628	59%	M=31	Low experience (59% less than 3 years)	Controlled before-after study	*Physician-directed:* 12-week, self-directed and team-based incentivized exercise program including self-reported exercise and gym attendance. Participants	No intervention	Post-intervention

									were encouraged to form teams of 5 for accountability and mutual commitment to exercise. Individual and team points were calculated and e-mailed to participants weekly.		
West et al.[57] 2014	US	Practicing physicians in the Department of Medicine at the Mayo Clinic in Rochester were eligible.	Department of General Medicine	74	65%	n/r	M=8 years	RCT	*Organization-directed (components from physician-directed interventions):* The intervention involved facilitated physician small-group curriculum: 19 biweekly facilitated physician discussion groups incorporating elements of mindfulness, reflection, shared experience, and small-group learning for 9 months. Protected time (1 hour of paid time every other week) for participants was provided by the institution.	No intervention	3 & 12 months

M= mean, RCT= randomized controlled trial; n/a= not available; n/r= not reported